ERCP81

USER MANUAL

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FOREWORD

PURPOSE

This document contains:

- a review of the general operation of an ERCP81
- instructions for installing and operating the system
- guidelines for troubleshooting

UPDATES

Version	Page index	Date	Description of changes
1	0	2006-03-02	Original document
1	1	2012-05-29	Update: improvement of drafting.

NOTES

The contents of this manual are subject to changes without notice.
BALOGH can not be held responsible for the consequences of any error, omission, or incorrect interpretation of the information.

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1 OBJECTIVE OF THE DOCUMENT

3.1. Purpose

This document provides useful information for the user that will integrate ERCP81 in a system. This User Manual deals with the following items:

- Package contents.
- Mounting information.
- Description of the ERCP81 product. This section provides a product overview, a quick description of the ERCP81 functions and how to interface the ERCP81 via a serial link
- Firmware upgrade procedure.
- Maintenance and troubleshooting help.
- Annexes

2 PACKAGE CONTENTS

The ERCP81 inductively coupled transponder is shipped in a labelled cardboard box.
When unpacking, please ensure that the following items are present:

- 1 x ERCP81 (with protection cap on connector),
- 1 x Technical data-sheet.

3 MOUNTING INFORMATION

3.1 Features

See the product's technical datasheet.

3.2 Recommended cable

- 6 or 8 wires:
  - 2 or 4 conductors for power supply (refer to the pin out hereunder).
  - 2 twin twisted pairs; line impedance: 120Ω (matched inside the unit) for the RS-422 link.

- 1 overall shield; it must be in contact over 360° to the metallic cable connector housing.
- Connection of conductors to the cable connector by crimping; conductor. wire gauge: 0,5 to 1,5mm².
- Outer diameter of cable: 8 to 1 2.5 mm (see data sheet, § accessories).

- Length:
  - For supply voltage: 24Vdc, a voltage drop of 3volts can be accepted, with:
    1) one pair of 1.5mm² diameter, max length of cable: 540m.
    2) one pair of 0.5mm² diameter, max length of cable: 180m.

  - For supply voltage: 29Vdc, a voltage drop of 8volts can be accepted, with:
    1) one pair of 1.5mm² diameter, max length of cable: 1200m.
    2) one pair of 0.5mm² diameter, max length of cable: 480m.

4 Product description

4.1 Overview

4.1.1 ERCP81

ERCP81 was developed for railway applications. This product is always operated in pairs, one on the ground and one on-board a vehicle. Once they are close enough, the two enter into radio communication exchanging messages through inductive coupling. The ERCP81 which is opposite is hereafter in this document referred to as the **counterpart**.

ERCP81 is a short range transmitter/receiver that dialog at 13.56 MHz. This integrated device includes an antenna and provides a cylindrical connector. The communication range is below than 1 meter.

Each ERCP81 is connected to a host or external controller, for example a programmable PLC or a computer, through a RS 422 serial link. The ERCP81 sends by radio the data received by the host. On the other hand, the data received by radio from the counterpart is transmitted periodically to the host. The behavior is symmetrical for both counterparts. The radio dialog is done in half-duplex secured by a 16-bit CRC and lasts while the counterparts remain in presence.

Both devices (the fix one and the mobile one) are identical. However, one must be declared as “Master” and the other one as “Slave” so that they don’t dialog in the same time. So, the master sends periodically a “Request to Send” frame. If a Slave receives it, it sends a data frame. Then the Master sends its data.

The role of the ERCP as Master or Slave is defined by the function ID of the message sent by the host. For example:

- If the host sends a message with a function ID = 3 on the serial link, the ERCP81 will be set into Slave mode.
- If the host sends a message with a function ID = 5 on the serial link, the ERCP81 will be set into Master mode.

4.1.2 Interchangeability/mixability with other Balogh products

ERCP81 can be mixed with and/or replaced by BALOGH ERES 1307 and 1308. ERES 1307 and 1308 are transmitters/receivers developed on the base of ERCP81, on which additional features have been integrated, like:

- 5 inputs. On discrete input is reserved to trigger into ERCP81 mode.
- 5 outputs. One discrete output is reserved to indicate counterpart presence.
- Inputs/outputs are available on an additional cylindrical connector.
- Preset radio frames. Up to 4 frames are stored in Non Volatile Memory, selectable through inputs.
- Periodic send of Life message on Serial link.
- Configurable temporizations saved in Non Volatile memory.

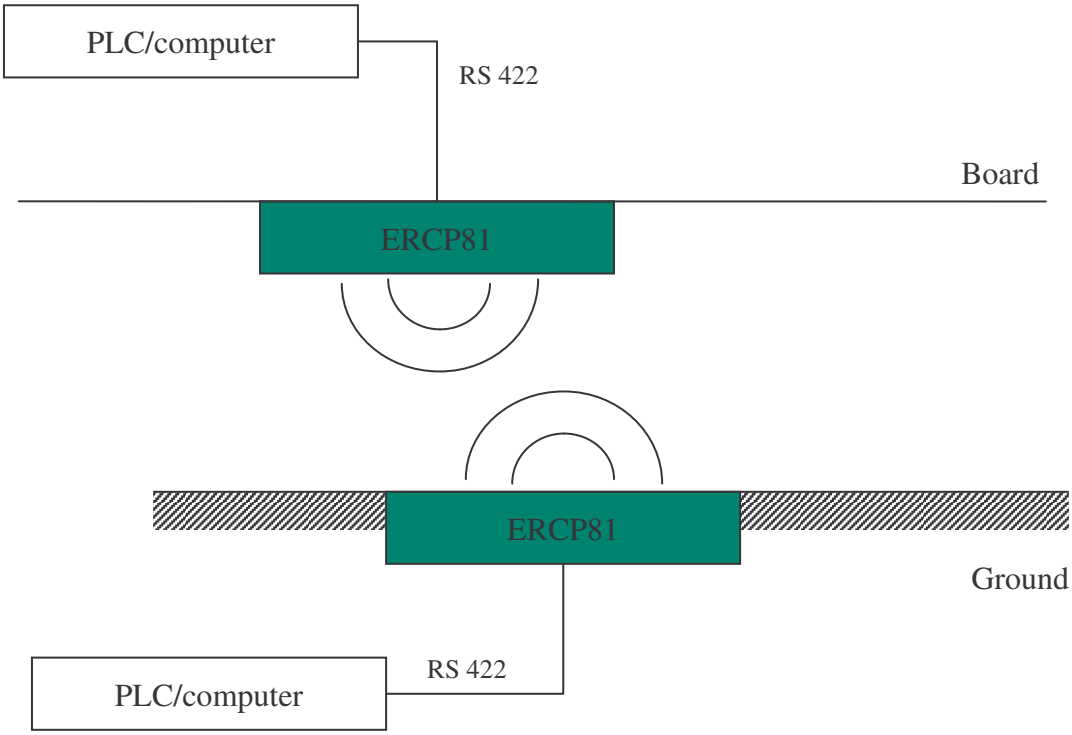
ERES 1307 and ERES 1308 are same products, excepted that they were developed on different hardware. They are used in safety systems, in which redundancy is required and the devices shall have different implementations to avoid common mode failures.

See documentations ERES 1307 and ERES 1308.

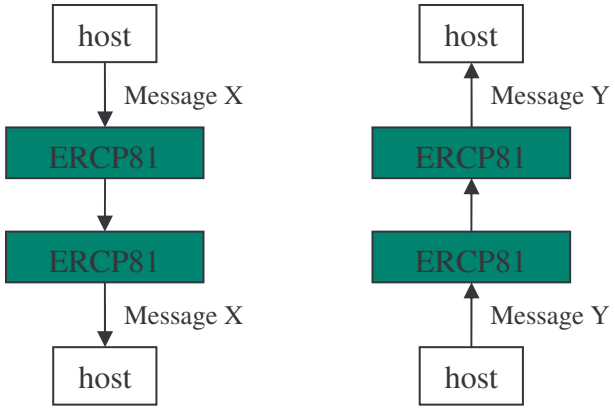
4.2 Functional description

4.2.1 Behaviour in operation

The figure below depicts a typical installation.



A couple of ERCP81 connected each to a host behave like a cross cable. It means that a message sent by a host to another one will be transmitted through the serial link and the ERCP81 couple, provided that they are close enough to communicate. Communication is full duplex: messages are sent and received in the same time.



So as to have a communication between ERCP81, one has to be configured as Master, and the other one as Slave. The host sends a command on the serial link to set the ERCP mode.

Commands that set the ERCP81 into Master mode are:

- MAID14 (function ID = 5),
- MAID6 (function ID = 6),
- MAID7 (function ID = 7),
- MAID9 (function ID = 9).

Commands that set the ERCP81 into Slave mode are:

- ESID14 (function ID = 3),
- ESID8 (function ID = 8).

These messages also transport data and some have an error counter. Once a valid serial link message is received, it is stored in an internal buffer, ready to be sent to the counterpart by radio. The only data that can change during the transmission from PLC to PLC is the error counter.

Communication principles are given hereafter:

4.2.2 Serial link protocol:

Messages exchanged on the serial link can be divided in to 3 categories:

- Data commands: they are synchronous commands sent to the counterpart. The list is given in the table below:

Function	Name	Description	Expected response
3	ESID14	Slave assignment. Send data to the counterpart. Data size is fixed to 14 bytes.	ACK, NAK, (none)
5	MAID14	Master assignment. Send data to the counterpart. Data size is fixed to 14 bytes.	ACK, NAK, (none)
6	MAID6	Master assignment. Send data to the counterpart. Data size is in the range [0, 32].	ACK, NAK, (none)
7	MAID7	Master assignment. Send data to the counterpart. Data size is in the range [0, 32].	ACK, NAK, (none)
8	ESID8	Slave assignment. Send data to the counterpart. Data size is in the range [0, 32].	ACK, NAK, (none)
9	MAID9	Slave assignment. Send data to the counterpart. Data size is in the range [0, 32].	ACK, NAK, (none)

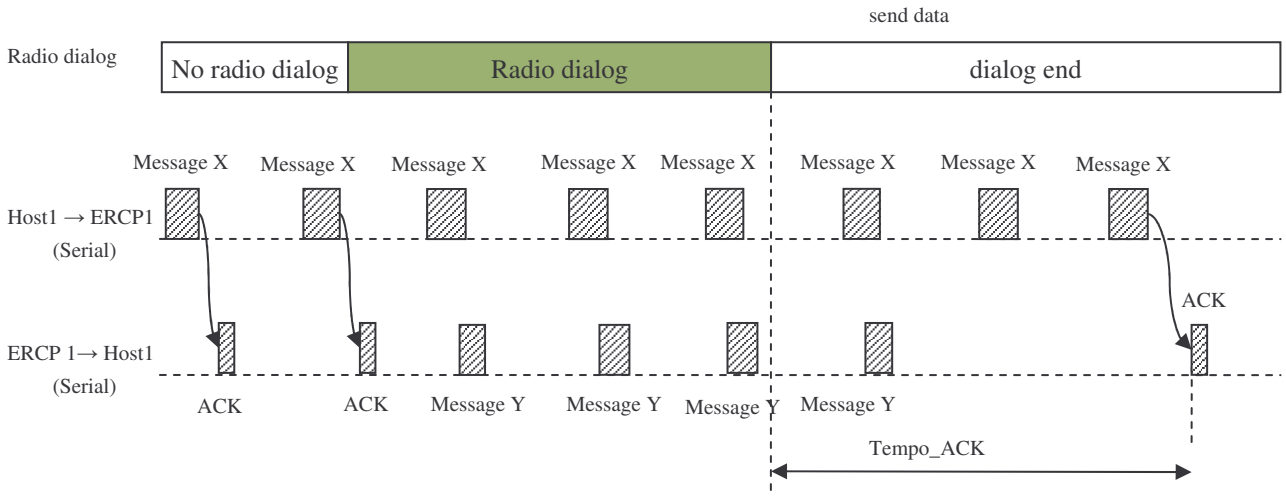
- Automatic messages: they are asynchronous messages sent by the ERCP81 to the host. They are message received from the counterpart, or ERR messages that indicate a radio communication failure.

Function	Name	Description
3	ESID14	Data received from the counterpart(14 bytes).
5	MAID14	Data received from the counterpart(14 bytes).
6	MAID6	Data and radio error counter received from the counterpart. Data size is in the range [0, 32].
7	MAID7	Data and radio error counter received from the counterpart. Data size is in the range [0, 32].
8	ESID8	Data and radio error counter received from the counterpart. Data size is in the range [0, 32].
9	MAID9	Data and radio error counter received from the counterpart. Data size is in the range [0, 32].
4	ERR	Radio transmission error.

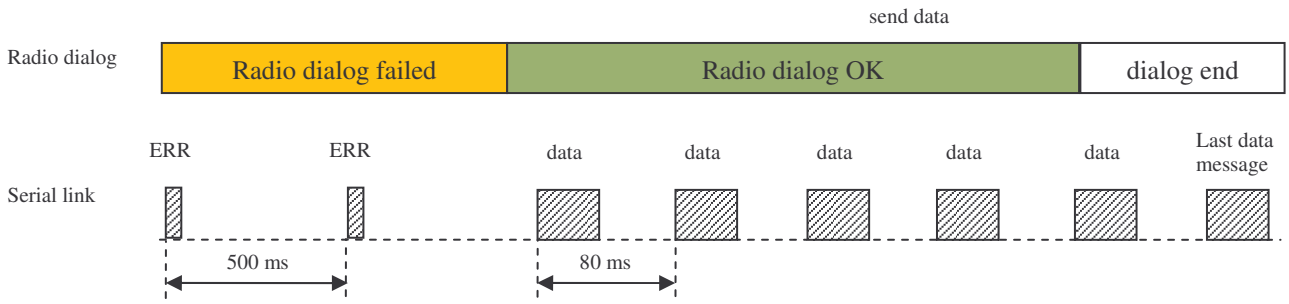
- Service commands. They are synchronous commands used to control or to get the ERCP81 status.

Function	Description	Expected response
0Ah	Read firmware version	Firmware version
12h	Read status	ERCP81 status
19h	Reset ERCP81	ACK, NAK, (none)
21h	Set ACK temporization	ACK, NAK, (none)
23h	Read ACK temporization	Temporization
10h	Read EEPROM contents	EEPROM data

Data messages from the host are acknowledged (ACK message) by the ERCP81, except during radio dialog. If the message received on the serial link is not valid (parity error, unexpected length ...), the ERCP81 returns a NAK message. The delay between last radio dialog and next acknowledged message (called tempo_ACK) is configurable and saved in Non Volatile Memory. The following scheme depicts messages exchanges between a host and an ERCP81.



Last data message to the host is repeated once after the counterpart has disappeared.
The diagram below gives the duration between messages sent on the serial link.

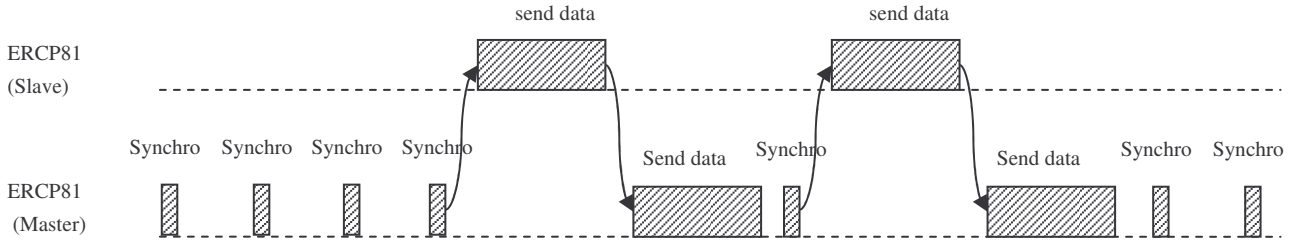


ERR messages are sent every 500 ms.
Data messages (MAIDx, ESIDx) period is about 80 ms.

When radio failures occur, an internal counter is incremented and ceiled to 15. This counter is used in some operation messages (see details in further section).

4.2.2.1 Radio protocol:

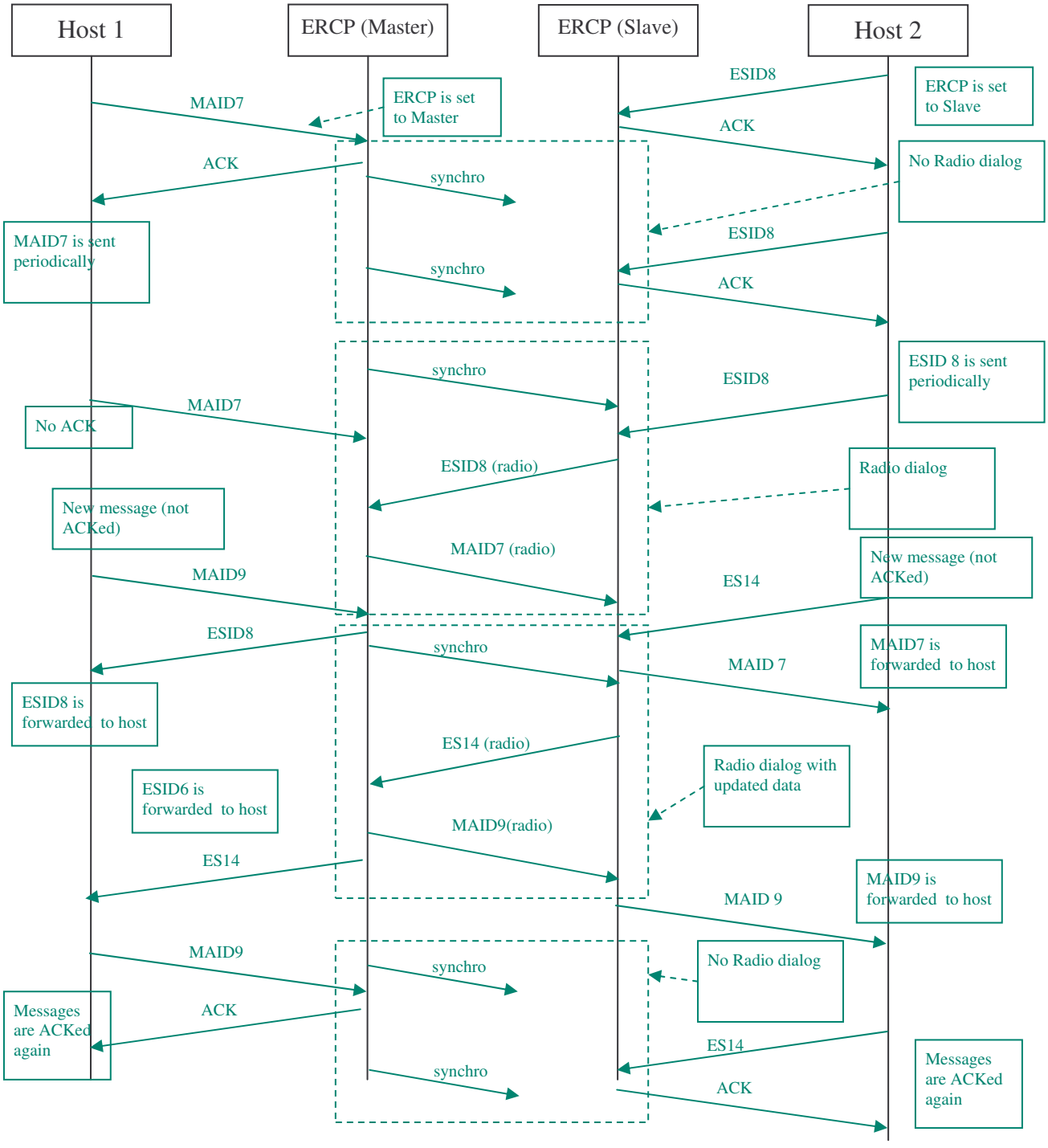
The master sends periodically a synchronisation pattern. The Slave waits for this pattern. When it receives the synchronisation pattern, it sends its data. Then the master sends its data. The diagram below depicts the transmission protocol.



4.2.3 Sequence diagrams

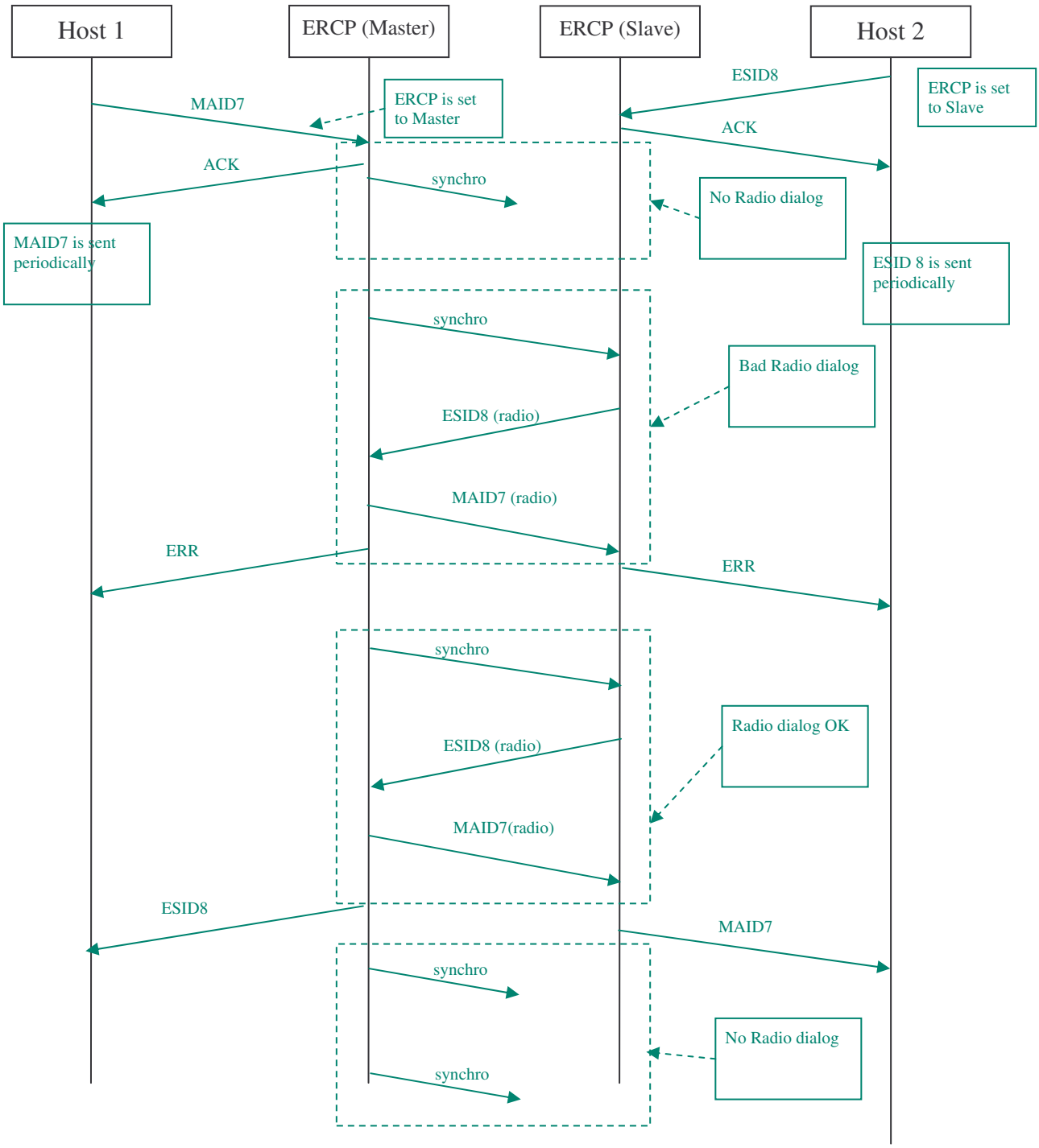
Following diagrams aim at understanding interactions between serial link messages and radio messages.

The sequence diagram below depicts a typical operation.



Nota : new messages are taken into account once the radio dialog is completed.

When the radio dialog failed (bad CRC, frame error, ...), ERR messages are sent on the serial link and repeated periodically.



4.3 Interfaces

4.3.1 Serial Link Interface

4.3.1.1 Transmission characteristics

Each ERCP81 is equipped with a bidirectional digital asynchronous serial link RS-422.

The transmission characteristics are:

- 19200 bauds
- 1 bit start
- 8 bits data
- 1 bit even parity
- 1 bit stop

Individual transmitted messages are separated by a silence of at least 5 ms.
Individual received messages must be separated by a silence of at least five characters, which corresponds to about 3 ms at 19200 bauds. The end of a message is determined after a 4.8 ms timeout.
Individual characters within a message must not be separated by more than two characters, which correspond to about 1.2 ms at 19200 bauds.
During reception each character is checked for parity. If all characters have the correct parity, the message is processed, otherwise it is ignored.

Due to historical reasons, several different message formats are used for communication between the ERCP81 and an external controller (host).

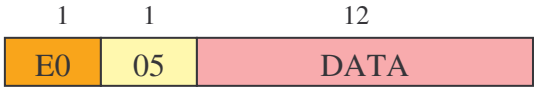
Following sections will detail the format of

- Master messages.
- Slave messages.
- ACK, NAK, ERR messages.
- Service messages.

4.3.1.2 Master messages

4.3.1.2.1 Message MA14 (ID = 5)

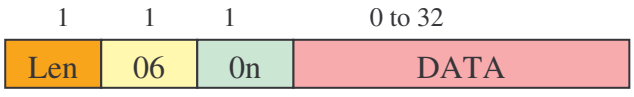
➔ Fixed-length frame (14 bytes) – ERCP81 mode:



E0 - Total length of message (14) encoded in the 4 high-order bits
Fn - Function ID = 5 (master assignment).

4.3.1.2.2 DATA - data (12 bytes) to processMessage MAID6

➔ Variable-length frame with header of 3 bytes (3+N):

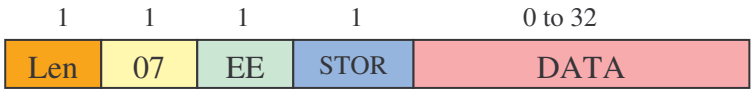


Len - Total length of message

06 - Function ID = 6 (master assignment)
0n - error counter (n) encoded in the 4 low-order
DATA - data to process

4.3.1.2.3 Message MAID7

➔ Variable-length frame with header of 4 bytes (4+N):



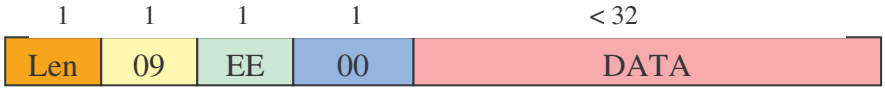
Len - Total length of message
08 - Function ID = 7 (master assignment).
EE - Inputs/Errors (inputs are used with ERES 1307/1308).

State of 4 inputs on counterpart				Error counter 0 to 15			
7							0
E4	E3	E2	E1	n3	n2	n1	n0

DATA - data to process

4.3.1.2.4 Message MAID9

➔ Variable-length frame with header of 4 bytes (4+N):



Len - Total length of message
08 - Function ID = 9 (master assignment).
EE - Inputs/Errors (inputs are used with ERES 1307/1308).

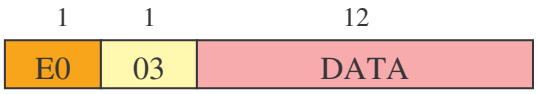
State of 4 inputs on counterpart				Error counter 0 to 15			
7							0
E4	E3	E2	E1	n3	n2	n1	n0

DATA - data to process

4.3.1.3 Slave messages

4.3.1.3.1 Message ES14 (ID = 3)

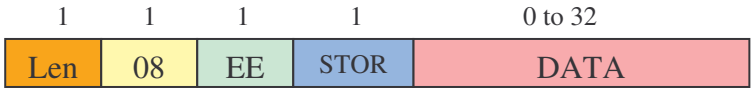
➔ Fixed-length frame (14 bytes) – ERCP81 mode:



E0 - Total length of message (14) encoded in the 4 high-order bits.
Fn - Function ID = 3 (slave assignment).
DATA - data (12 bytes) to process.

4.3.1.3.2 Message ESID8

➔ Variable-length frame with header of 4 bytes (4+N):



Len - Total length of message
08 - Function ID = 8 (slave assignment).
EE - Inputs/Errors (inputs are used with ERES 1307/1308).

State of 4 inputs on counterpart				Error counter 0 to 15			
7							0
E4	E3	E2	E1	n3	n2	n1	n0

DATA - data to process

4.3.1.4 ACK, NAK, ERR messages

➔ Fixed-length frame 2 bytes:

- ACK message. Message returned to the host when a valid message was received by the ERCP81. It is send when no radio dialog is established.

ACK : 02 01

- NAK message. Message returned to the host when an invalid message was received by the ERCP81. It is send when no radio dialog is established.

NAK : 02 02

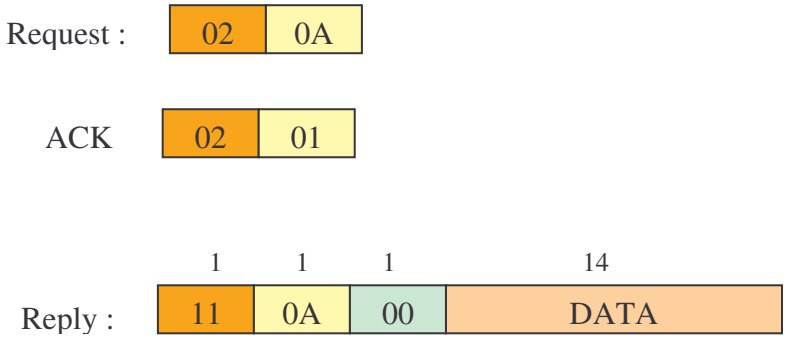
- ERR message. Message sent to the host in case of bad radio reception.

NAK : 02 02

4.3.1.5 Service Commands

4.3.1.5.1 Read firmware version

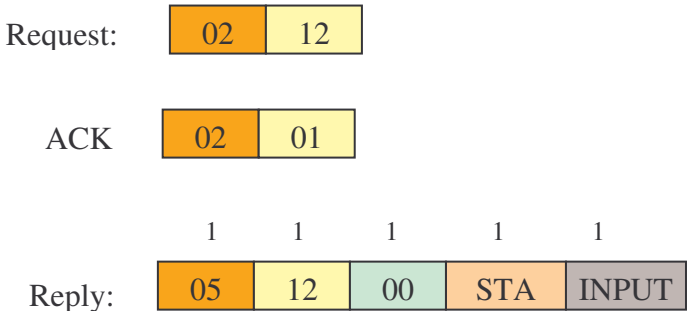
Reads a variable length character string, e.g.:



DATA = "ERCP81 0.1.2" (14 bytes including the final \0)

4.3.1.5.2 Read status

Reads **status** and **inputs** (2 bytes)



where the **status** byte (STA) has the following structure:

7	6	5	4	3	2	1	0
MA	MR	TP	TM	DM	PR	VA	EE

EE: eeprom OK, active 1
VA: valid exchange seen, active 1
PR: counterpart present, active 1
DM: demo mode, active 1
TM: test mode, active 1
TP: pre-recorded identifiers OK, active 1 (not used)
MA: Master, active 1

The INPUT field is not used in ERES 1307/1308 only.

4.3.1.5.3 Reset

Force a processer reset:

4.3.1.5.4 Set ACK temporization

Set the tempo_ACK value. This tempo is the delay between the end of the radio dialog and next ACK.

	1	1	1
Commande :	03	21	T1

ACK/NAK	02	01/02

T1 is a multiple of 10 ms. This allows a temporization from 10 ms to 2.55 seconds.
The default value is 10 ms.
If T1 = 0, this parameter is initialized to its default value.

4.3.1.5.5 Read ACK temporization

This command allows to read the value of tempo_ACK.

Commande :	02	23

ACK	02	01

	1	1	1	1
Réponse :	04	23	T1	nu

T1 is the value of tempo_ACK, in multiples of 10 ms.
Last byte is not used.

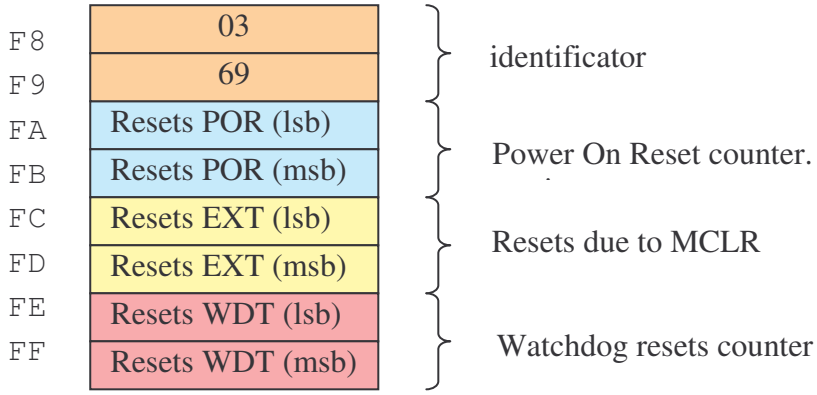
4.3.1.5.6 Read EEPROM contents

➔ Fixed-length frame with 3 bytes header:

1	1	1	1	1	1
06	10	00	ADH	ADL	NB

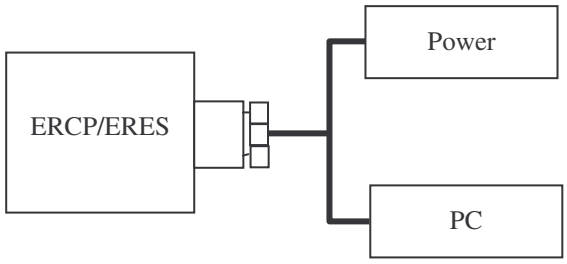
06 - Total length of the message.
10 - Function ID = 0x10.
00 - must be 0.
ADH - Address (Most Significant byte).
ADL - Adresse (Least sigificant byte).
NB - Number of bytes to read (up to 32).

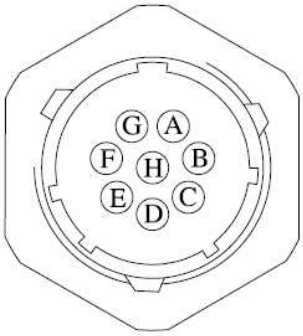
This command is useful to read reset counters. This can be done at address 248. Reset counter are organized as follows in the EEPROM:


F8
F9
FA
FB
FC
FD
FE
FF
03
69
Resets POR (lsb)
Resets POR (msb)
Resets EXT (lsb)
Resets EXT (msb)
Resets WDT (lsb)
Resets WDT (msb)
identificator
Power On Reset counter.
Resets due to MCLR
Watchdog resets counter

5 Firmware update procedure

Connect the ERCP81 to an RS232 port on a PC as shown in the diagram and table below:





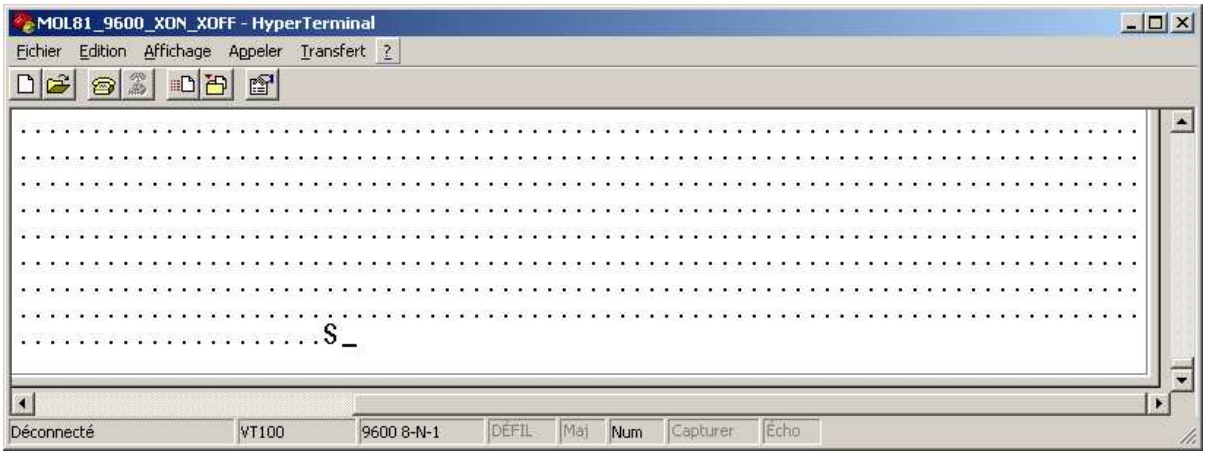
Pin	Name	PC RS232	Power
A	Ual		24V
B	Tx+		
C	Rx+		
D	0 V		0V
E	Tx-	Rx	
F	Rx-	Tx	
G	Ual		
H	0 V	0V	

In order to update the firmware, the product must first be put into boot mode. This is done by applying a **voltage of between 5V and 12V onto pin F while powering up**. This voltage is then removed. This is normally done using special equipment supplied by BALOGH.

Once in boot mode, run "Hyperterminal" on the PC with the following characteristics: text mode, 9600 bauds, no parity, Xon Xoff enabled : 9600 8-N-1.

The update file must be in “HEX” format.

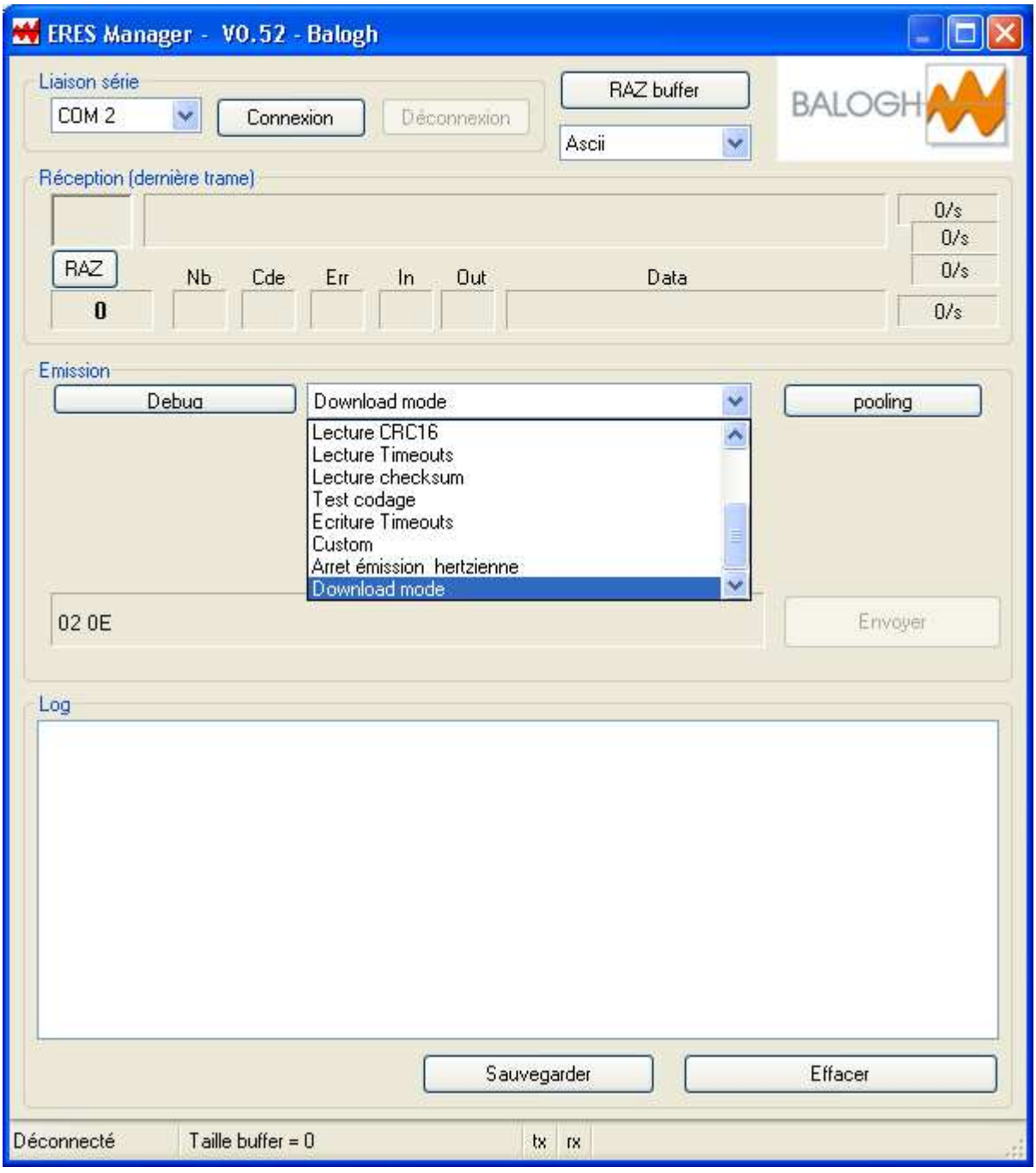
During upload, the bootloader sends a "." character after processing each line of the hexfile. After all lines have been successfully processed, the "S" character is sent (see screen-capture below). If the “S” is not received, a problem has occurred and the procedure must be repeated.



Nota: this procedure can also be done with tools delivered by BALOGH.

The procedure is the following one:

- Start the BALOGH ERES.exe tool (version V0.52 or later).
- Select the COM port and then clic on “connect”.
- Select the “Debug” button and the select “Download mode“ in the list.
- Clic on “Send”.
- Clic on the “Disconnect” button.



- Then start the BALOGH Flash.exe tool.
- Select the HEX file to download and then start the upgrade.
- Follow instructions.

6 MAINTENANCE

Troubleshooting involves investigating the two main external interfaces:

- radio communication between an ERCP81 and its counterpart,
- serial link communication between a master ERCP81 and a slave ERCP81.

If, after checking these interfaces for correct operation, a system malfunction persists, the ERCP81 will need to be replaced as follows:

1). Removal of faulty ERCP81:

- disconnect power,
- remove connector,
- remove ERCP81 from mount.

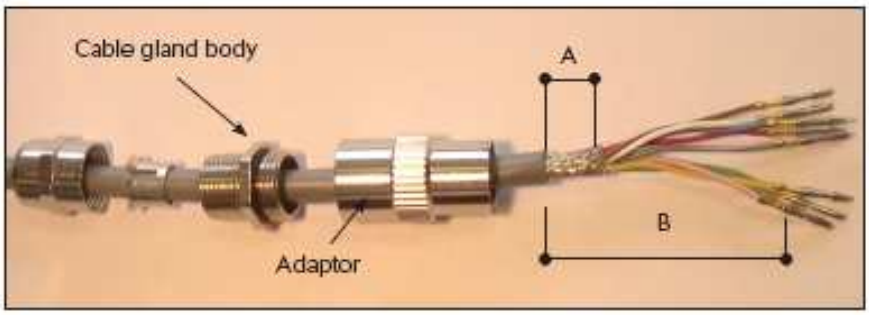
2). Installing a new ERCP81:

- fix on mount,
- connect cable,
- connect power.

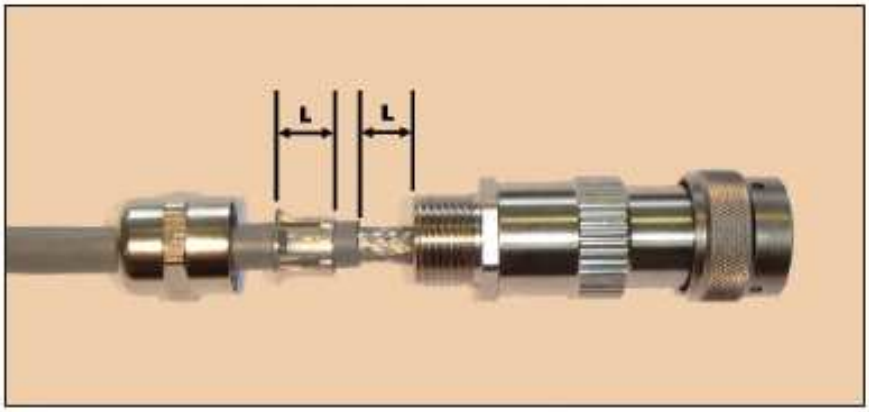
ANNEXE A: CABLE ASSEMBLY FOR SHIELDED CONNECTORS

Shielded connectors

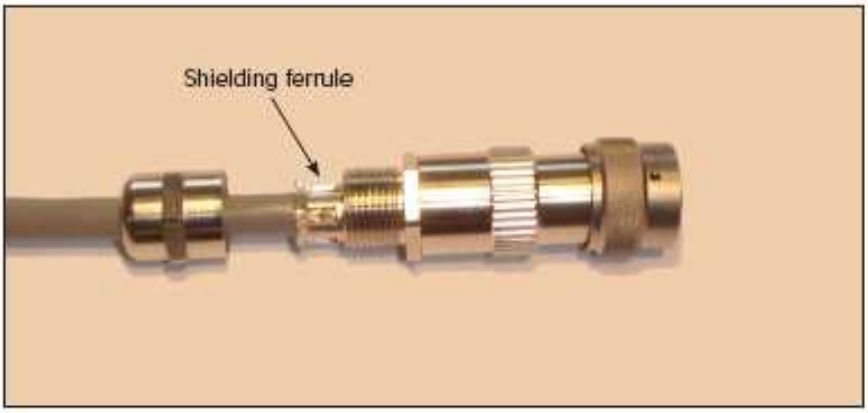
How to assemble shielded connectors...



1. Put all the parts over the cable as shown on the picture.
2. Keep about 10mm of the shielding (dim A)
3. The total strip length (dim B) of the outer jacket has to be defined practically. This length is defined by the length of the adaptor, the cable gland body, type of contacts, the gender of the plug connector and the dim. L as shown on picture 2.
4. The strip length of the individual wires is defined in the different contact sections.



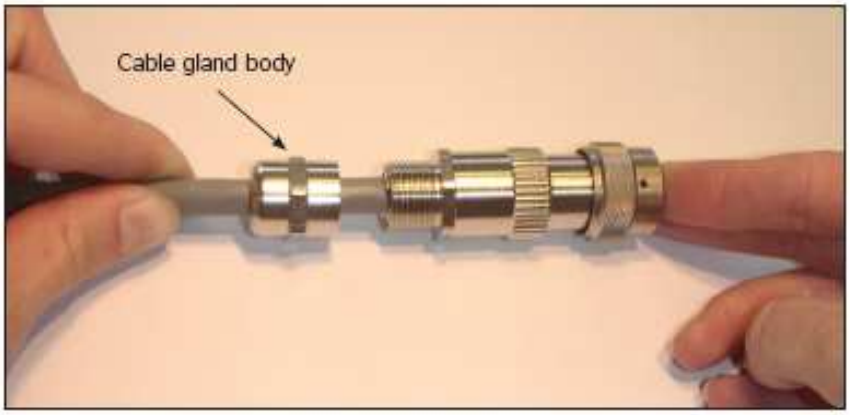
5. Put the contacts in the corresponding cavities
6. Screw / tighten the adaptor and the cable gland body. The max tightening torque is indicated in the table below.
7. Make sure the dim L is kept after the assembly of the adaptor and the cable gland body. This dimension is needed to allow repair of the harnessing. It will also release the stress on the contacts when the assembly of the cable clamp is finished.



8. Carefully slide the shielding ferrule until is positioned over the shielding and as close as possible to the cable jacket.
9. Make sure that the shielding ferrule is correctly polarised. This polarisation is a feature to avoid twisting of the cable during the tightening of the cable gland.

Shielded connectors

How to assemble shielded connectors... (con't)



10. Manually push the shielding ferrule inside the cable gland body.
11. Make sure the shielding ferrule does not slide over the cable jacket.
12. Hold the cable in this position prior to the assembly of the cable gland hood.

13. Hold the cable in the same position as explained above and tighten the cable gland hood. The max tightening torque is indicated in the table below.
14. To ease the tightening operation, an empty receptacle connector can be used when fixed in a bench.
15. Make sure that the cable is not twisted during the tightening operation.

Max tightening torques in Nm

Shell size	Cable gland body	Cable gland hood
10	6	5
12	10	8
14	10	8
16	14	12
18	14	12
20	24	20
22	24	20
24	24	20

Above tightening torques are indicative and have to be adjusted in accordance to the cable diameter and application.